Table 3-18

Identification and Screening of Technologies for Soil and Sediment – Upland Areas Investigation Area H1 Mare Island, Vallejo, California

General Corrective Action	Corrective Measure Technology Type	Technology Process Options	Technical Implementability	Screening Results
Institutional Controls	Use Restriction	Groundwater Use Restriction	Applicable with most alternatives. Not often used as a stand-alone alternative.	Retained
	Alternate Water Supply	Alternate Water Supply	Provide alternative water supply to current and potential groundwater users. The groundwater at the site is not a potable source.	Retained
	Access Restriction	Fencing	Potentially applicable with most alternatives.	Retained
	Deed Restriction	Land Use Restriction	Land Use restrictions would restrict the use of the property to a specific use.	Retained
Containment	Capping	Soil Cap	A compacted, low-permeability soil cap would act as a barrier to prevent ingestion, direct contact, and inhalation of contaminants in soil to human and ecological receptors. A soil cap would also reduce the mobility of contaminants by minimizing their vertical migration to groundwater. Would not be effective for localized "hot spots".	Retained
		Asphalt/Concrete Cap	An asphalt or concrete cap would act as a barrier to prevent ingestion, direct contact, and inhalation of contaminants to human and ecological receptors. An asphalt or concrete cap would also reduce the mobility of contaminants by minimizing their vertical migration to groundwater. The thickness of the asphalt cap would be significantly less than a RCRA or low-permeability soil cap. Long-term monitoring and maintenance would be required. An asphalt or concrete cap may not be an aesthetic approach for containment in areas intended for future recreation. Would not be effective for localized hot spots.	Eliminated
Collection	Excavation	Soil excavation	Effective and implementable option for handling contaminated soil in limited hot spot areas. Excavated soil may be used in combination with treatment such as stabilization. Excavated soil may require dewatering and associated water may require management. Collection technologies must be teamed with a disposal technology, and may also require treatment prior to disposal.	Retained

Table 3-18

Identification and Screening of Technologies for Soil and Sediment – Upland Areas Investigation Area H1 Mare Island, Vallejo, California

General Corrective Action	Corrective Measure Technology Type	Technology Process Options	Technical Implementability	Screening Results
Treatment	*In situ*: Biological Processes	Bioremediation	Bioremediation involves the activity of naturally occurring microbes to enhance degradation of organic contaminants. The *in situ* bioremediation of soil typically involves the percolation or injection of groundwater or uncontaminated water mixed with nutrients and saturated with dissolved oxygen. Typically effective for organic contaminants. Not effective for metals, PCBs, and low permeability soil/sediment. The primary contaminants in soil at IA H1 include metals, PCBs, and petroleum hydrocarbons. In site bioremediation would be effective for treating the petroleum hydrocarbons but not the metals and PCBs. It is not cost effective to implement different technologies for different contaminant groups at the same location. Due to the heterogeneous nature of the disposal areas at IA H1, injection is not easily implementable.	Eliminated
		Bioventing	Oxygen is delivered to soil by forced air to stimulate aerobic biodegradation of organic contaminants, particularly petroleum hydrocarbons and VOCs. Not effective for metals and PCBs and low permeability soil. Due to the heterogeneous nature of the disposal areas at IA H1, injection is not easily implementable.	Eliminated
		Natural Attenuation	Natural processes such as dilution, dispersion volatilization, biodegradation, adsorption, and chemical reactions with soil materials reduce contaminant concentrations. Most high molecular weight organic and many inorganic contaminants will be immobilized in the subsurface matrix. This technology requires long-term monitoring. Although organic chemicals may be bioremediated over time, metals must rely on dispersion for concentration reduction.	Eliminated
		Land Treatment	Contaminated surface soil is treated in place by tilling to achieve aeration. Aerating by periodically tilling enhances biological activity. Effective for treating petroleum hydrocarbons but not effective for metals. Land treatment is only effective for treatment of surface soils. Soil contamination at IA H1 is not limited to the surface soils. Petroleum hydrocarbon contamination is typically present in subsurface soils rather than surface soil.	Eliminated

Table 3-18

Identification and Screening of Technologies for
Soil and Sediment – Upland Areas
Investigation Area H1
Mare Island, Vallejo, California

General Corrective Action	Corrective Measure Technology Type	Technology Process Options	Technical Implementability	Screening Results
		Phytoremediation	Phytoremediation is a process that uses plants to remove, stabilize, and destroy organic and inorganic contaminants in soil. The mechanisms of phytoremediation include enhanced rhizosphere biodegradation, phytoextraction, phytodegradation, and phytostabilization. Plants can uptake metals and be harvested. This technology is limited to shallow zones and plant root zone. The depth of contamination in the uplands areas extends to up to 10 feet in some areas. Also not effective for petroleum hydrocarbons and PCBs.	Eliminated
	In situ: Physical/Chemical Processes	Stabilization/Solidification	Involves injecting or mixing in place chemical compounds into contaminated soil, which renders contaminants insoluble or binds contaminants chemically or physically to soil matrix. Effective for metals and PCBs but nor for petroleum hydrocarbons and free product. Difficult to implement in situ due to heterogeneous nature of disposal areas at IA H1.	Eliminated
		Electrical Separation	Involves inducing an electrical current in the soil, which causes migration and concentration of metals for their removal. This is an experimental technology and difficult to implement.	Eliminated
		Pneumatic Fracturing	Process of injecting pressurized air beneath the soil surface to develop cracks in low permeability and over-consolidated sediments. This process increases the efficiency of other *in situ* processes and enhances extraction efficiencies by increasing contact between contaminants adsorbed onto soil particles and the extraction medium. Primarily used to fracture silts, clays, shale and bedrock. Should not be used in areas with seismic activity.	Eliminated
		Soil Vapor Extraction	A vacuum is applied to the soil to induce the controlled flow of air and remove organics from the soil. Not effective for metals, petroleum hydrocarbons, or low permeability dredge material.	Eliminated
		Soil Flushing/Extraction	Involves injection of an aqueous fluid into contaminated soils, causing mobilization of sorbed contaminants. The solution is then extracted for treatment and recirculated. May be difficult to capture all of the injected solution. This technology offers the potential for recovery of metals. Low permeability soils are difficult to treat. The geology and nature of disposal areas of IA H1 are not amendable to this treatment technology.	Eliminated

Table 3-18

Identification and Screening of Technologies for
Soil and Sediment – Upland Areas
Investigation Area H1
Mare Island, Vallejo, California

General Corrective Action	Corrective Measure Technology Type	Technology Process Options	Technical Implementability	Screening Results
	In situ: Thermal Processes	Vitrification	Uses an electric current for the conversion of contaminated soils into molten glass and a crystalline structure with very low leaching or volatilizing/gas emission characteristics. Applicable for metals; however, few full-scale applications available. This is a very energy-intensive process. Due to the high water table, nature of disposal areas, depth of contamination, and potential for exposure to ordnance, this technology is not appropriate.	Eliminated
		Thermally Enhanced Soil Vapor Extraction	Involves using steam/hot-air or electric/radio frequency heating to increase the mobility of organics and facilitate extraction. Not effective for metals or low permeability soil.	Eliminated
	Ex Situ: Biological Processes	Slurry Phase Biological Treatment	Involves the controlled treatment of excavated soil in a bioreactor. Sizing of materials prior to placing into reactor and dewatering of soil fines after treatment may be difficult. Management of recycled wastewater is also required. Since PCBs have a low biodegradability, this technology would be relatively ineffective in reducing concentrations of these chemicals. Not effective for metals.	Eliminated
		Controlled Solid Phase Biological Treatment	Processes include prepared treatment beds, biotreatment cells, soil piles, and composting, where soil is mixed with bulking agents and organic amendments such as woodchips, hay, manure, and vegetative wastes to enhance biodegradation of organic contaminants. Treatment volume is significantly increased by amendment addition. Not effective for metals. This treatment would not be time and cost effective for the target contaminants and volume of contamination at IA H1.	Eliminated
		Landfarming	Contaminated soils are applied onto the soil surface and periodically turned over or tilled into the soil to aerate the waste. May be amended with bulking agents to increase oxygen availability or nutrients. Effective for organics. Not effective for metals. The soil contamination at the Uplands Area of IA H1 is not limited to the surface soils.	Eliminated

Table 3-18

Identification and Screening of Technologies for Soil and Sediment – Upland Areas Investigation Area H1 Mare Island, Vallejo, California

General Corrective Action	Corrective Measure Technology Type	Technology Process Options	Technical Implementability	Screening Results
	Ex Situ: Physical/Chemical Processes	Stabilization/Solidification	Similar to *in-situ* stabilization except the soil is excavated and mixed with stabilizing agents utilizing a pugmill system or other method of external mixing. Effective for PCBs and metals but not for petroleum hydrocarbons and free product. Most of the areas of contamination within the Uplands Area of IA H1 contain petroleum hydrocarbons and/or free product. Would be teamed with collection and disposal technologies.	Retained
		Chemical Oxidation/Reduction	Oxidation/reduction reactions involve the transfer of electrons from one compound to another and converts contaminants to less toxic compounds that are more stable, less mobile, and/or inert. The oxidizing agents most commonly used are ozone, hydrogen, peroxide, and chlorine. Effective for some metals, PCBs, and petroleum hydrocarbons. Less effective on free product.	Eliminated
		Soil Washing	The soil washing process extracts contaminants from soil using a liquid medium such as water or a surfactant. Liquids generated during washing will require management. The treatment may require more than one solvent to extract different contaminants. Effective for metals, PCBs, and petroleum hydrocabons. Difficult to implement with low permeability soils and clays. Several solutions would be needed for the contaminant groups.	Eliminated
		Dehalogenation	Contaminated soils are mixed with a reagent and heated in a vessel to dehalogenate halogenated aromatic compounds. Effective for PCBs but not for metals and petroleum hydrocarbons.	Eliminated
		Solvent Extraction	Waste and solvent are mixed in an extractor, dissolving the organic contaminants into the solvent. Traces of solvent may remain in the soil matrix. After extraction, the solvent requires management. Not effective for metals.	Eliminated
		Soil Vapor Extraction	A vacuum is applied to a network of above-ground piping to enhance volatilization of organic compounds. Not effective for PCBs, metals, or petroleum hydrocarbons.	Eliminated

Table 3-18

Identification and Screening of Technologies for Soil and Sediment – Upland Areas Investigation Area H1 Mare Island, Vallejo, California

General Corrective Action	Corrective Measure Technology Type	Technology Process Options	Technical Implementability	Screening Results
		Particle Separation	Reduction of volume of contaminated soil through particle separation using sieves of various diameters based on contaminants tendency to adsorb better to smaller or clayey particles rather than larger particles. Can be combined with other treatment technologies. Effective for metals, SVOCs, and pesticides. Difficult to implement with silty clay soils such as the Young Bay Mud. Most of the contamination with the Uplands Areas of IA H1 is limited to fill and disposal areas or within the underlying dredge material. This technology would not be effective for these soil types.	Eliminated
	Ex Situ: Thermal Processes	Plasma Hearth Process	This process uses high temperatures with plasma as its heat source. Transforms waste material into a stable basalt-like rock for long storage. Not a full-scale technology.	Eliminated
		Thermal Desorption	High-temperature thermal desorption volatilizes and desorbs organic contaminants from the soil without combustion. Organic contaminants are not destroyed during process. Not effective for metals.	Eliminated
		Pyrolysis	Chemical decomposition is induced in organic materials by heat in the absence of oxygen. The target contaminant groups are SVOCs, not effective for metals.	Eliminated
		Incineration	High temperatures are used to volatilize and combust organic contaminants. Not effective for metals.	Eliminated
Disposal	On-Site Disposal	On-site Disposal	Treated soil would be placed back into excavations or untreated soil would be combined with other disposal materials within the IA H1 Landfill Area..	Retained
	Off Site Disposal	Off-site Landfill	Transport waste material to an off-site disposal facility. Soil/sediment would have to meet LDRs prior to disposal, if necessary.	Retained

The shading indicates the option was eliminated from further consideration.